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DEPARTMENT OF AGRICULTURE.

BOTANICAL DIVISION.

BULLETIN NO. 1.

REPORT

OF AN

INVESTIGATION OF THE GRASSES

OF THE

ARID DISTRICTS

OF

KANSAS, NEBRASKA, AND COLORADO.

BY

Dr. GEORGE VASEY, Botanist.

PREPARED UNDER THE DIRECTION OF THE COMMISSIONER OF AGRICULTURE.

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INVESTIGATION OF GRASSES OF THE ARID DISTRICTS OF KANSAS, NEBRASKA, AND COLORADO.

WASHINGTON, *September 29, 1886.*

Hon. NORMAN J. COLMAN,
Commissioner of Agriculture:

DEAR SIR: In accordance with your commission to make an investigation of the grasses and forage plants of the arid districts of the West, I have the pleasure of informing you that I have recently spent about six weeks in an examination of that part of the arid region embraced in the States of Kansas, Nebraska, and Colorado, and in the northeastern part of New Mexico.

The eastern boundary of the arid region has been commonly fixed at the one hundredth meridian. It has been estimated that nearly one-half of the land belonging to the United States, exclusive of the Territory of Alaska, lies west of this line, and amounts to some 900,000,000 acres. Much the larger part of this immense region consists of mountains and arid land. A large part of the land on the Pacific coast is productive without irrigation, and some of the finest land for grazing purposes lies in the mountain valleys and parks, where there is an abundant rainfall. The remainder of this great domain consists mainly of arid land, such as the high mesas of Western Texas, New Mexico, Arizona, Southern California, Utah, Nevada, and Wyoming, in addition to those portions of Kansas, Nebraska, Colorado, and New Mexico before mentioned.

Various estimates have been made as to the amount of this arid land; probably two-thirds of all the territory west of the one hundredth meridian may be considered of this class, and so far as it has been utilized, has been chiefly occupied for cattle and sheep ranches, for which purpose alone it was thought to be adapted.

NORTHEASTERN NEW MEXICO.

The time at my disposal only admitted of an investigation of the part of this region which I have mentioned, and I will first speak of the northeastern part of New Mexico. This is separated from the great plains of Colorado by an eastward projection of the Raton range of mountains. This range rises to the height of about 8,000 feet at the crossing of the Atchison, Topeka and Santa Fé Railroad. The town of Trinidad lies at the base of the range on the northern side, at the

elevation of 6,000 feet, and here the railroad begins the ascent of the mountain, following the winding of a small stream. Near the summit it passes through a tunnel, then emerges in New Mexico, and rapidly descends to the town of Raton, which is at an elevation of about 6,700 feet. Here the plains recommence, stretching eastward to the east line of the Territory, thence into the region called "No Man's Land" and into the "Panhandle" of Texas. Southward they extend through the Territory, but undergo a considerable change in character after reaching about the thirty-fifth parallel of latitude, or about 140 miles from the northern boundary.

The western boundary is the base of the Rocky Mountains, which trend somewhat to the southwest, thus giving a greater breadth in the southern part, but the average breadth from the mountains to the east line may be reckoned at more than 100 miles. This is the best large body of grazing land in the Territory. The elevation along the base of the mountains at the west is greater than it is in Colorado, and along the railroad the altitude is over 6,000 feet.

The mesa slopes eastward gradually to the line of the Territory, where the altitude is about 4,000 feet. This region is almost entirely covered by several Mexican land grants, particularly those known as the Maxwell and Mora grants, and is included in the counties of Colfax, Mora, and San Miguel. Little or no agriculture has been attempted except with irrigation, and that is generally pursued by the native Mexicans, who are generally contented with a few acres each on the water courses. In some of the valleys among the foot hills, however, are fertile spots where some cultivation has been successfully attempted without irrigation. According to the statement of Mr. Clarence Gordon in the census report for 1880, there were in that year about 220,000 head of cattle in these three northeastern counties, or over 60 per cent. of all that were in the Territory. Mr. Gordon estimates that there are 11,500,000 acres of available pasturage land in this portion of the Territory, which would give an average of about 52 acres to the head of stock; but the ground is also shared by a large number of sheep. Colfax County was the most heavily stocked, and gave an average of 24 acres to the head, while Mora County gave 35 acres to the head, and San Miguel County 55. That portion of the mesa near the Raton Range is so elevated as to be only serviceable for cattle pasturage during five months of summer, and is chiefly occupied as a sheep ranch.

The grasses of this region are mainly the same as prevail in Colorado, viz, gramma and buffalo grass, in variable proportion, but the gramma generally greatly predominating. Several other kinds occur in certain localities, as on rocky hillsides and on bottom land, but form only a small proportion as compared with those prevailing on the mesa. These will be noticed in another place. The quantity of grass upon the ground varies with the situation and soil. In the west part of the Mora grant there is a wide stretch of most excellent grazing land. On bluffs and

rocky ground the soap-weed, a kind of Spanish bayonet (*Yucca angustifolia*) frequently occurs, and occasionally may be seen a large, branching, thistle-like cactus (*Opuntia arborescens*).

Over the larger part of this mesa the capacity for supporting cattle will probably average from 15 to 20 acres to the head. There are, however, large tracts which cannot safely be utilized from the absence of running water. This difficulty will eventually be overcome by the sinking of wells.

Mr. Calhoun, of Watrous, a well-known stockman, remarked, "Our great want is a more productive grass. The quality is not so great an object as the quantity."

Mr. Gordon estimates that there are 11,500,000 acres in this region available for stock-raising, and that in 1880 it was stocked on the average at the rate of about 52 acres to the head. But the full grazing capacity of the land cannot be realized under the rancho system. In order to do this the cattle ranges must be restricted in extent, with provision for winter feeding, water, and shelter. If to this we add cultivation of the land and pastures of more productive grasses, we may expect greatly increased population and wealth. Mr. D. W. Brewster has a section of land on the dry mesa about 12 miles east of Las Vegas, where he has dug a well and this year broken 30 acres, and expects to break 80 acres, on which he will try the experiment of cultivation. The result of this experiment will be watched with great interest. In a deep cañon, 28 miles east of Springer, M. W. Mills, esq., has 100 acres under cultivation in fruit trees, and has had good success. Whenever these land grants are arranged for subdivision at reasonable prices, a movement of immigration will probably take place. The towns of Raton, Springer, and Las Vegas are the principal ones on the railroad in a distance of 150 miles.

THE NORTHERN PLAINS.

We will now return to the arid region north of New Mexico. This is bounded on the west by the Rocky Mountains, and extends eastward to the one hundredth meridian in the States of Kansas and Nebraska, a distance of more than 300 miles. The elevation at the base of the mountains is about 5,500 to 6,000 feet. North of Colorado the high mountain range breaks down into the elevated Laramie plains.

This region is drained in the northern part by the Platte River, the north fork in Nebraska and the south fork in Colorado; by the Republican River in Southern Nebraska, the Smoky Hill in Kansas, and the Arkansas and its branches in Southern Colorado and Kansas. It is an immense treeless plain, sloping eastward at the rate of about 10 feet to the mile. It is cut up in many places by dry channels, called *arroyos*, which carry off the surface-water during rains and convey it to the larger streams. In the central part of the Colorado plateau is an elevated ridge, known as the "divide," which separates the waters of the

Platte from those which make their way on the south to the Arkansas. This ridge is about 100 miles from east to west and 60 miles from north to south. The southward drainage slope toward the Arkansas River is said to be about 40 feet to the mile. Occasional springs are found, but large areas occur without any water.

There are some extensive tracts of very sandy land, sometimes thrown into ridges, and sometimes into small, shifting hillocks. But by far the larger part of the surface of this great tract is a rich mixture of loam and clay, increasing in richness, for the most part, as the land descends to lower altitudes. The same observations will apply mainly to the eastern portions of the tract in Kansas and Nebraska, where, at the one hundredth meridian, the elevation is about 2,500 feet.

Near Denver and northward on the Platte and its branches are some of the best agricultural lands of Colorado. They are irrigated by ditches and canals drawn from the mountain streams. In this part of the State are the enterprising towns of Boulder, Longmont, Fort Collins, and Greeley. In the southern part the Arkansas has been drawn upon for purposes of irrigation. But the irrigable lands constitute but a small part of the great plains. They are mostly elevated above the streams, and for a supply of water must depend mainly upon wells and artificial reservoirs. The rainfall over this region is from 15 to 20 inches per year, increased occasionally in the southeastern part to 24 inches. The plains constitute about one-third of the entire area of the State of Colorado.

CATTLE ON THE PLAINS.

It is stated that in 1884 there were in Eastern Colorado about 800,000 cattle, occupying an area of some 20,000,000 acres, or about 40 acres per head. Occupying the same territory there were also about 1,000,000 head of sheep. Some parts of this region have evidently been overstocked, but there are large areas in the eastern part of the State which have been little utilized on account of the scarcity of water.

In Kansas and Nebraska west of the one hundredth meridian the elevation runs down from an average of 3,500 feet to that of some 2,500 feet in a distance of about 120 miles. I have not been able to obtain any recent estimates as to the quantity of cattle on ranches in this district. The number has been greatly reduced within two or three years, partly by the removal of many herds to more northern ranges and partly by means of the heavy losses of stock during the last winter from exposure to an excessively severe occurrence of storms and blizzards, by which some herds were almost entirely destroyed.

There are some sections where the supply of running water is very limited, and these have not been much occupied.

There is reason to believe that the unproductive character of much of this region has been greatly exaggerated, and many portions of this Territory have recently been the field of a great rush of immigration, by which the larger part will soon be absorbed by homesteads and pre-

emption claims for the purpose of general cultivation. The attempts at agriculture which have been made here during the past two or three years have been attended with considerable success, possibly owing to favorable seasons, but the most sanguine expectations are entertained by the settlers.

The scene of greatest activity has been along the line of the Atchison, Topeka and Santa Fé Railroad. From Dodge City westward to La Junta new towns are springing up as if by magic, and the surrounding country is being rapidly settled. Cimarron, Belfast, Pierceville, Garden City, Hartland, Syracuse, Cooledge, and Lamar are some of these new points of settlement. Several new and extensive irrigating canals, drawn from the Arkansas River, have been carried through portions of the country, which will enable much land to be brought under irrigation. The bottom lands and second bottoms are flat and well adapted to irrigation. The high lands have a rich soil, supporting a good body of gramma and buffalo grass. On the Kansas Pacific Railroad there is also considerable activity in the way of settlement. Sorrento, Kit Carson, and Coronada are booming towns on this road in Eastern Colorado and Colona, Collyer, Grinnell, Sheridan, and Wallace on the same road in Western Kansas. The railroad through this section runs mostly on the divide or highest and least watered part of the country. Wallace County seems to be particularly wanting in large streams. Some of the first branches of the Smoky Hill River have their rise in it, but the supply both of water and trees is small. There has been little improvement or settlement in the county until recently. The village of Wallace is built on the Government reservation of Fort Wallace, which reservation is 2 miles wide by 7 miles long. The buildings of the old military post are about 2 miles from the village. They are mostly in a state of dilapidation, but a portion are substantially built of stone and are well preserved.

A large and substantial dam which was built across the small stream and utilized chiefly for an ice-pond still remains in a damaged condition, and with some repairs could be employed for irrigation. The village is on the high upland, and is supplied with water mainly from wells of different depth. On the highest levels water is usually reached at about 150 feet. One-half the land lying along the railroad is owned by the company, and is not yet offered for sale, and settlers have generally gone beyond the railroad limits. The few attempts which have been made at cultivation without irrigation have been principally for the purpose of obtaining forage crops of corn and millet, and have been so successful that trials are now being made of wheat and other farm crops. At this village and in the vicinity the grasses are gramma and buffalo, in variable proportions, the buffalo predominating on the highest levels, but the gramma taking the lead elsewhere. The ground is well covered and affords excellent pasturage, and is quite capable of affording summer pasturage for stock at the rate of 10 acres to the head.

On the Burlington and Missouri Railroad, in Northeastern Colorado, new settlements are forming. Akron is a new town on the naked plain, near no stream of water. The land is said to be rich; certainly it has this season produced promising crops of corn and millet on newly-broken sod. Water is obtained at the depth of about 75 feet. Half a mile north of the station is the artesian well which was sunk by the United States Government to the depth of 1,200 feet and then abandoned. The water now rises freely in the well to within 140 feet of the surface, and is utilized to supply the wants of settlers in the vicinity. The grasses of the prairie are the same as at Wallace and elsewhere, but somewhat more sparsely covering the ground. On the same railroad, in Southwestern Nebraska, Benkelman, Culbertson, and McCook are thrifty towns on the Republican River, where the land is fertile and considerable of it under cultivation. At McCook, on high ground north and west of the town, fields of strong, promising corn and millet were growing on the dry prairie. The gramma and buffalo grasses cover the soil richly and afford excellent pasturage. The greatest difficulty away from the streams on the highlands is the want of water, to obtain which it is sometimes necessary to sink wells 150 to 300 feet. Wheat has yielded as high as 40 bushels to the acre without irrigation. In the town are planted several kinds of trees, as ash, box-elder, elm, white maple, and catalpa, which seem to be making healthy growth.

On what is called the Julesburg Branch of the Union Pacific Railroad new towns are springing up, and land is rapidly being located. Atwood, Sterling, Iliff, and Sedgwick are within the boundaries of Colorado, and Ogallala, O'Fallon, and North Platte are in Nebraska. At the points in Nebraska particularly there have been many land entries and considerable cultivation commenced. At North Platte and many miles west of that place the river bottom is several miles wide, and contains rich meadow land, where great quantities of grass are cut annually for hay. This consists of several coarse species, principally *Panicum virgatum*, *Agropyrum glaucum*, and *Andropogon provincialis*, intermixed with sedges and rushes. In some places over large areas the principal grass is that which is called alkali or salt grass (*Distichlis maritima*), which makes a close, thick mat, looking like a pasture of blue-grass.

The highlands away from the river are covered with the ubiquitous gramma, with occasional buffalo-grass and blue-joint. On high levels, 200 feet above the river, on new breaking, are fields of corn, which give promise of a good yield.

SUPPORTING CAPACITY OF THE ARID PLAINS.

There is a surprising difference in the estimates as to the supporting ability of these plains, some stating that it requires 40 or 50 acres to maintain one animal, others giving 20 or 30 acres, and still others 10 or 15 acres. All these estimates are correct as to certain localities, and over the entire region it may be considered probable that the average

amount required would be about 15 acres to the head. In the Census Report for 1880, Mr. Clarence Gordon says of Kansas west of the ninety-ninth meridian: "Where there is sufficient water, 10 acres of range will support one head of neat stock. When we find that there were in estimate 80 acres to each unit of stock, we have to remember that at least one-half of the occupied area is scantily watered, and that the region is not fully stocked." Elsewhere he says that in 1880 there were in the same region over 184,000 head of stock, and that the approximate acreage for stock occupation was 15,782,880 acres. And in Nebraska, west of the ninety-ninth meridian, there were 571,386 head of cattle, with an approximate acreage of occupation of 26,000,000 acres, or about 48 acres per head.

It is impossible to realize the full capacity of these districts under the ranch system. This can only be accomplished by limiting the extent of the range and the size of the herds, so that they can be properly cared for as to water, shelter, and winter feed; and this would require the cultivation of a part of the land. The question of water supply on the high lands will in time be successfully solved, so that every fertile acre can be beneficially employed. And with these conditions fulfilled the supporting capacity of the country can be easily doubled and quadrupled.

A PASTORAL COUNTRY.

Sufficient time has not elapsed to determine what will be the ultimate success of general agriculture in this section, but there can be no doubt that the country is eminently adapted to pastoral uses, and the settlers who are now filling up the country would do well to direct their efforts to stock raising and to dairy interests.

Notwithstanding the great development of the cattle industry during recent years, statistics show that the production of beef has not kept pace with the increase of population, and to supply the great demand for meat will require not only the usual product of the ranches, but opens also an excellent opportunity of cattle farming, where the additional labor and care employed will not only increase the supply, but find ample remuneration.

HOW TO INCREASE THE GRASS SUPPLY.

The inquiry will naturally arise in thoughtful minds, cannot the grazing capacity of this region be increased by substituting more productive grasses, those which will not only endure the aridity of the climate, but also clothe the ground more completely, and furnish a more abundant growth? There can be no doubt as to the high nutritive value of the gramma and buffalo grasses, but the yield is so light as to require a large area for cattle to range over to obtain support. There can be no improvement in this respect without cultivation of the soil.

It has been argued that in this arid region agriculture cannot be successful from a want of sufficient rainfall. But it is now claimed by

those residing on the soil that this is erroneous. It is said that in the natural condition of the soil the full benefit of the rainfall is not obtained, that the ground is so densely packed that it is impervious to moisture, so that a large share of the rainfall rapidly runs into the arroyas and streams as it would from a roof, whereas if the ground were plowed and pulverized a large part of the rainfall would be retained for the gradual nourishment of such plants as were on the ground. Nature has here done the best she could under the circumstances. But nature never spontaneously presents us with great and luxuriant fields of grain or other vegetables ready to the hand of man. But by means of agriculture man directs and controls nature, and she willingly submits to his guidance. Man has learned to select those plants, grains, and grasses which are best adapted to his wants, and to grow them to the exclusion of others. This is the essence of agriculture. Nature shows her willingness even here to respond to the ameliorating influences of cultivation. No sooner is the ground plowed, and corn, sorghum, or millet planted, than a crop many times as heavy as that of the native soil is at once produced. Even if nothing but such annual crops as those can be raised on this soil the cultivation of an eighth part of the land would be sufficient to make safe the keeping of twice the number of cattle which could subsist otherwise. But it is reasonable to conclude that nature will be as ready to help in the production of perennial grasses as she is in the annual ones. There is every reason to expect that even the gramma-grass may be made to double its yield by cultivation. But there is a considerable number of grasses native to this district which are much more thrifty and productive than the gramma and buffalo, and if they were selected and sown upon the properly prepared land there can be no doubt that a great improvement in the grass production would be effected. Indeed we should extend our inquiry to foreign grasses cultivated in similar situations.

ESTIMATE OF RESULTS TO BE OBTAINED.

Between the thirty-seventh and forty third degrees of latitude, and between the one hundredth and the one hundred and fifth degrees of longitude, there are embraced not far from 120,000 square miles of surface. There can be little doubt that one-half of that quantity is capable of sustaining, under proper management, with provision for winter food and shelter, at least 50 head of cattle to the square mile, or 3,000,000 cattle on the entire tract. By many of the residents this estimate would be considered much too small. And can we not expect that the time is advancing when we shall see all this vast area so improved as to fully realize this estimate, not only for the limited area above mentioned, but for many other sections of what are now called the arid lands? If also we can gradually introduce more productive grasses we can readily anticipate a still further development of the cattle industry.

THE CRUCIAL TEST.

I have stated my belief that many other grasses and forage plants might be substituted for the prevailing ones on this arid tract which would be more productive.

But this is a question which can only be settled by experiment. Such grasses and forage plants require to be subjected to careful and prolonged trials in order to obtain proof of their relative values under different conditions of soil, moisture, and location.

Such experiments are difficult and expensive, and cannot well be made by private individuals; hence it is highly important that the Government should provide an experimental station in a central and characteristic location, where all the commonly cultivated grasses and forage plants, and also the most promising native ones, could be thoroughly tried under various conditions. This would be greatly in the interest of that large body of settlers who are now taking possession of the country, and who, without the aid of such information as could thus be obtained and communicated, will be exposed to many losses and disappointments in prosecuting agriculture under the peculiar circumstances here existing. A properly conducted and well-continued series of experiments in this direction would result in important discoveries of great value to the future residents in this arid district.

LOCATION OF A GRASS-EXPERIMENT STATION.

I have spoken above of the Government reservation of Fort Wallace, and I am induced to recommend the utilization of this property for the purpose of an experimental station.

I recommend this because it is central, easy of access, and typical of this large district of arid country. I recommend it also because here is land presenting a suitable variety of elevation, moisture, &c., with all the buildings which would be needed for the equipment of such a station. I recommend it because its scope of work would be peculiar to, and in the interest of a peculiar region of country, greatly needing the information which it would secure.

A very moderate appropriation, expended under the Commissioner of Agriculture, could here be made productive of a great amount of good. The problem presented could not be solved in one or two years, but would require a well conducted and continued series of trials under varied conditions.

The editor of the Wallace County Register, in a recent issue, makes the following very rational remarks:

There can be no good reason assigned why the old Government post, now fast falling into decay, but still capable, with small expense, of being fitted up for comfortable residences and stabling, should not be utilized for the benefit of the whole country. There is no finer belt of land anywhere in the great West than we have within a

radius of 100 miles, taking Wallace as a center. All this great area lies in what has been known as the Great American Desert. It is not desert, but the very richest of soil, and possesses the finest climate in America. As yet it is undeveloped. Only one thing is surely known of it; that is, it is a fine stock country.

Nearly one-fourth of all this land (not including the railroad grant) has been taken up under the timber-culture act. One-half of this portion will be ready for planting by the spring of 1888, the other half by the spring following. Nearly all of the remainder has been taken up under the other acts of Congress governing the public domain. There is but little of it left to be taken. These homesteaders know but little of what the country will produce. A farm of the character contemplated would greatly aid them.

APPENDIX.

The native grasses occupying that portion of the arid region here investigated are numerous, but only two kinds play the most important part in the support of animal life. These are, botanically, *Bouteloua oligostachya* and *Buchlæ dactyloïdæ*, commonly called gramma-grass and buffalo-grass, respectively, but frequently called indiscriminately buffalo-grass. They are of low growth, forming patches of greater or less extent, with spaces of bare soil between the patches. The leaves are short and mostly crowded close to the ground. There are several species of *Bouteloua* or gramma-grass, but the one above named is the principal one on the great stretches of upland. The others occur locally, some on rocky ridges and some in what is called bottom land. In valleys and bottoms near the mountains the dwarf gramma-grass, *Bouteloua prostrata*, often carpets the ground over large areas. This extends, at least, from Northern Colorado to Santa Fé, N. Mex. The common gramma varies much in size and vigor, according to its location. In rich moist bottom land it may grow 2 feet high and form a pretty close sod, but on the elevated dry plains it becomes greatly reduced in size and productiveness. Wherever it is not too closely cropped by cattle it seeks to send up its flowering stalks, sometimes not more than 6 inches high, but usually a foot or more. Near the top of the slender stalk are from one to two, or rarely three, flower-spikes, which when mature stand out nearly at right angles, and are an inch to an inch and a half long, with the flowers all arranged on one side of the spikes.

The true buffalo-grass, *Buchlæ dactyloïdes*, forms extensive cushion-like beds, covering the ground closely with its short, compact foliage, which is of a lighter color than the gramma. This grass is very peculiar in one respect. It is of a diœcious habit—that is, the two sexes grow on different plants, or if on the same plant they are not on the same stalk. Usually, however, they are wholly distinct and in different patches. The male spikes resemble in appearance those of the gramma, but are much smaller, and the stalks never grow tall. The female flowers are inconspicuous, generally being concealed among the leaves near the ground, and seed is rarely formed, the plant being mainly propagated by its short-jointed, creeping runners, after the manner of Bermuda-grass. According to my observation the gramma-grass is much the most common, but the two are generally associated in varying proportions, but together forming from 75 to 90 per cent. of the whole grass

product. There are several different grasses, known under the names of blue-stem, blue-joint, and blue-grass, all of which are different from the blue-grass of the East.

One of these, sometimes called Colorado blue-stem, is botanically called *Agropyrum glaucum*. It has a stiff, rigid stem and leaves, which are usually of a bluish-green color. On hard, dry soil its growth is low and sparse, only here and there a scattered stalk with a flower-spike somewhat like a starved, beardless head of wheat, but in low, moist ground it often grows with great vigor 2 or 3 feet high, and wherever it is abundant it is considered valuable for hay, and is a common resort for cattle in winter. It is most common near the mountains, but extends into Western Kansas and Nebraska. Another grass, frequently called the blue-stem, or blue-joint, of Kansas, is botanically called *Andropogon provincialis*. On the prairies of Eastern Kansas and Nebraska this is a conspicuous and well-known grass, very highly esteemed for hay. It is said that it is gradually crowding out the gramma and buffalo grasses. It is found, in some localities, quite to the base of the mountains, and is every where esteemed a good grass for hay. It grows erect, frequently to the height of 5 or 6 feet. The leaves are long and abundant; the stem has frequently a bluish color, and has at the top a cluster of from 3 to 5 flower-spikes, each being 2 or 3 inches long, and generally purplish in color.

There is another species much resembling this, which is botanically called *Andropogon Hallii*, and it prevails in very sandy soil; its roots are thick and penetrate deeply in the soil, keeping it fresh and vigorous in the driest time. This is sometimes called sand-grass, and it is said to be greatly sought for by cattle in winter. It grows from 3 to 5 feet high; the flower spikes when developed are hairy, and have a white or yellowish color, and the leaves and stem are commonly a light bluish-green color.

Another species of this family, called *Andropogon scoparius*, grows in dense tufts or bunches, generally on thin soil, or on bluffs and hills, but frequently also on bottom land, and is called bunch-grass. Apparently the same species in a somewhat different variety grows in the East, and is one of the so called sedge-grasses. It is probably what is referred to by some Western writers as sage-grass. It is frequently cut for hay, and serves a good purpose as winter forage.

Another important and valuable grass occurring in low or moist ground, usually near streams, is *Panicum virgatum*, which is sometimes called wild red-top, or sometimes switch-grass. It varies in height from 2 to 4 feet, with long leaves and a wide-spreading panicle of flowers. It is abundant on the native prairies in Eastern Kansas, and forms a good proportion of the wild grass there cut for hay. It also forms an important part of the native meadow-grasses in the valley of the Platte as far west as O'Fallon, and in smaller quantities to the base of the mountains.

Another species of this genus occurs in Texas, New Mexico, and Southern Colorado, which has the name of Vine Mesquit. It is botanically called *Panicum obtusum*. I found patches of this growing in Southern Colorado, making an even grassy surface about 2 feet high, and appearing as if it would cut 2 tons per acre. I also saw it in considerable quantity in hay brought into the Pueblo market. It frequently throws out runners several feet long (6 to 8 feet sometimes), which at intervals form thickened woolly knots or nodes, which sometimes take root. It deserves attention with reference to its agricultural value.

One of the so-called bunch-grasses, botanically called *Oryzopsis cuspidata*, occurs near the mountains in sandy soil, but I did not observe it over the eastern part of the arid district. In Southern New Mexico and Arizona, however, it is said to be an important grass. Associated with *Andropogon Hallii* in very sandy districts is another tall grass, also called sand-grass, which is botanically, *Ammophila longifolia*. It is coarse and tough, and its principal value seems to be as a refuge from starvation by cattle in the winter. It prevails on the sand dunes and sand hills of the most barren districts.

Another grass of very different habit and growth is sometimes also called sand-grass, salt-grass, and alkali-grass, botanically called *Distichlis maritima*. This is a low, very leafy grass, frequently forming the principal part of the vegetation in alkaline soils, though not confined to such. There seems to be a difference of opinion as to the value of this grass, some regarding it as useful, others as of no value.

Wild rye-grass, botanically, various forms of *Elymus canadensis*, is frequent in low grounds and borders of streams, and where it occurs in sufficient quantity is cut for hay, and is esteemed one of the best kinds.

Among other grasses having some value, and occurring in some localities, may be named *Sporobolus cryptandrus*, *Sporobolus airoides*, *Chrysopogon nutans*, *Hilaria Jamesii*, *Bouteloua racemosa*, *Stipa spartea*, *Koeleria cristata*, several species of *Muhlenbergia* and *Munroa squarrosa*. Some of these may prove to be valuable in cultivation for this arid region. Several worthless annual grasses are often abundantly mixed on the plains with the gramma and buffalo, such as *Aristida purpurea*, *Festuca tenella*, *Hordeum jubatum*, and *Elymus Sitanion*. Some of these are injurious on account of the barbed awns which cause sore mouths in animals and work into the wool and even into the flesh of sheep.

ACREAGE REQUIRED FOR THE SUPPORT OF STOCK.

Mr. H. M. Taylor, agent of the Bureau of Animal Industry, in his report for 1885 says, "from 40 to 50 acres are required to support one cow or horse on the arid regions of the plains."

Mr. S. H. Standart, another agent of the same Bureau, says:

The amount of acreage it requires to support one animal on the range in this State (Colorado) is $3\frac{1}{2}$ acres on the average in ordinary seasons. The reports are from 13 to 100 acres, according to locality.

The above estimates can only apply to the most barren parts of the arid districts. I think it can safely be said that there is very little land in Western Kansas and Nebraska where the native vegetation will not give support to cattle at the rate of 10 acres per head, and the ability of the land may readily be doubled by agricultural means.

AGRICULTURE ON THE ARID PLAINS.

The Akron (Colorado) Pioneer Press, August 20, 1886, says:

The office of the Pioneer Press resembles somewhat an agricultural hall at a county fair. Corn, millet, blue-joint, potatoes, buckwheat, oats, flax, beans, &c., that will compare favorably with any State in the Union. They were grown on sod in Colorado, the great American desert, by tenderfeet.

In the Homeseeker's Guide, published at Potter, Cheyenne County, in Southwestern Nebraska, are statements of the results of several instances of farming in that county last year, in which corn, potatoes, vegetables, turnips, &c., planted on sod land gave excellent results.

In the Denver Times, August, 1886, is the following article:

The bountiful yield of agricultural products in Northwestern Nebraska is a matter of surprise to all heretofore strangers to this locality. Many homesteaders who came here last spring doubting and timid, are now enthusiastic with the outlook. Why should any one distrust a country where soil yields a plentiful harvest for the mere planting, and where boundless grazing fields furnish pasturage for vast herds of cattle the year round? (Sidney Telegraph.)

The above is a sample of the reports which are coming in from the arid region to the east and northeast of Denver, along the Union Pacific and the Burlington Roads. Not only Western Nebraska, but Western Kansas and Eastern Colorado are apparently moving forward in the agricultural line. Reports are to the effect that settlers from the eastward are crowding the rangers in the eastern halves of Arapahoe, Weld, and Bent Counties. They have generally settled upon the high lands, and have planted crops which have had no water except that which has fallen from the skies. Strange as it may seem to the average man, who has been taught to regard the plains east of Denver as of no worth whatever, the crops are reported as prospering. One man is represented as having a 10-acre field of corn which averages 8 feet in height. The importance of such development cannot be overestimated. If good crops can be regularly grown upon the plains lands without irrigation, the question of securing dense population in Colorado may be regarded as settled.

Surveyor-general Lawson, of Colorado, in a recent report to Commissioner Sparks, says:

The lands upon the plains in the eastern section of the State are being rapidly settled upon by a thrifty, determined class of farmers, who come with the avowed purpose of making permanent homes, and who claim that the so-called "Great American Desert" is no desert at all, but a most fertile region capable of sustaining a teeming population. They claim with apparent confidence that the notion that agriculture cannot be profitably pursued in any portion of these plains except where irrigation is practicable is altogether erroneous, and maintain that there is ample rainfall to all the region east of the Rocky Mountains to secure abundant crops upon the soil, which is rich and genial, and that the apparently arid and unproductive character of these lands arise from the fact that in their natural state the water deposited by the snows of winter and the rains of spring and summer have flowed from the surface and been carried off by the arroyas and sandy ravines in the proportion of at least four-fifths, whereas when the soil shall be plowed and cultivated it will

absorb and retain the moisture in the same proportion, not more than one-fifth of the water flowing off into gulches and arroyas. They point with confidence, in illustration of this idea, to the fact that as the plowshare has advanced westward in the States of Kansas and Nebraska the "desert" of the old geographies has disappeared.

LOSSES OF CATTLE UNDER THE RANCH SYSTEM.

The losses of stock on ranches, from starvation and exposure, varies greatly in different seasons and in different localities, being seldom less than five per cent.

Mr. J. N. Bradley, an inspector of the Bureau of Animal Industry, says in his Report for 1885, page 427:

The ranchmen calculate to lose about 3 to 5 per cent. from exposure, and consider it less expensive than providing shelter and winter food.

But these losses during some winters are greatly exceeded, in Southern Kansas the past winter amounting in many instances to the loss of the larger portion of the herds. A similar condition existed in Eastern Colorado, as will be seen from the following item from a Colorado paper:

A correspondent writing under date of July 23 from Apache to the Walsenburg Cactus says: For the past two days the round-up has been in the Apache Valley. The report of the 100 cowboys who comprise the force is anything but encouraging as to the losses of the past winter. Many put the estimate of losses of acclimated stock as high as 75 per cent.; the most hopeful say 50 per cent. Among the dogies shipped in last fall scarcely a remnant remains. One cattle company that turned loose 1,800 head of through Texas stock have found out, at a cost of 10 per cent. of their investment, that they have less than 100 head left. A cattleman of this neighborhood who went into the winter with 1,000 head has so far been able to find less than a dozen.

But the actual loss of life from starvation and exposure is not the only consideration. Even among those cattle which survive the winter there is always a great reduction of flesh and condition. Mr. S. H. Standart, agent of the Bureau of Animal Industry, says:

The loss of flesh during the winter from want of shelter is 12 per cent. In Dakota the loss of flesh during the winter is 17½ per cent. (Report for 1885, p. 327.)

We would therefore hail with satisfaction such a change in the cattle industry as would obviate these risks and losses and bring it into the hands of land-owners, who, by better care and management, will make it possible to raise twice as many cattle, besides extending the dairy and sheep interests.

CHANGES ARE COMING.

Rapid changes are coming over our neighboring county of Bent. Though heretofore recognized as a leading and almost exclusive stock-raising region, large ditch enterprises have been projected there within a couple of years, and attention is directed quite generally to farming. With the ditches, new people, that know nothing of the range-stock business, have come in. Old-time ranchmen are considering how they can bring their herds to the limits of a pasture, and how to provide feed to supplement their abridged ranges. The town-boomers of Western Kansas have invaded the eastern borders of the county this year, and are booming no less than three new

towns within a few miles of each other. At the same time the older towns of Las Animas and La Junta have been infused with new energy and are making substantial growth. (Review and Standard, Pueblo, Colo.)

From the New York Tribune:

Theodore Roosevelt has come from the West with a springy step and bronzed countenance, and the general air of buoyancy which is the result of contact with the free air of Dakota prairies. He says that the days of excessive profits in the cattle business are over, because there are too many people in the business, and the cattlemen have to pay the penalty of crowding cattle more thickly on the prairies than the grass will stand. Mr. Roosevelt thinks that the present system of cattle grazing will eventually cease and the business take a different form in different localities. The land that is fitted for agriculture will be taken up by the farmers, and the grazing lands will gradually be fenced in and the great ranches be broken up to make place for smaller ranches.

Respectfully submitted.

GEO. VASEY,
Botanist of the Department.

ILLUSTRATIONS.

Bouteloua oligostachya	Gramma-grass, Pl.	I
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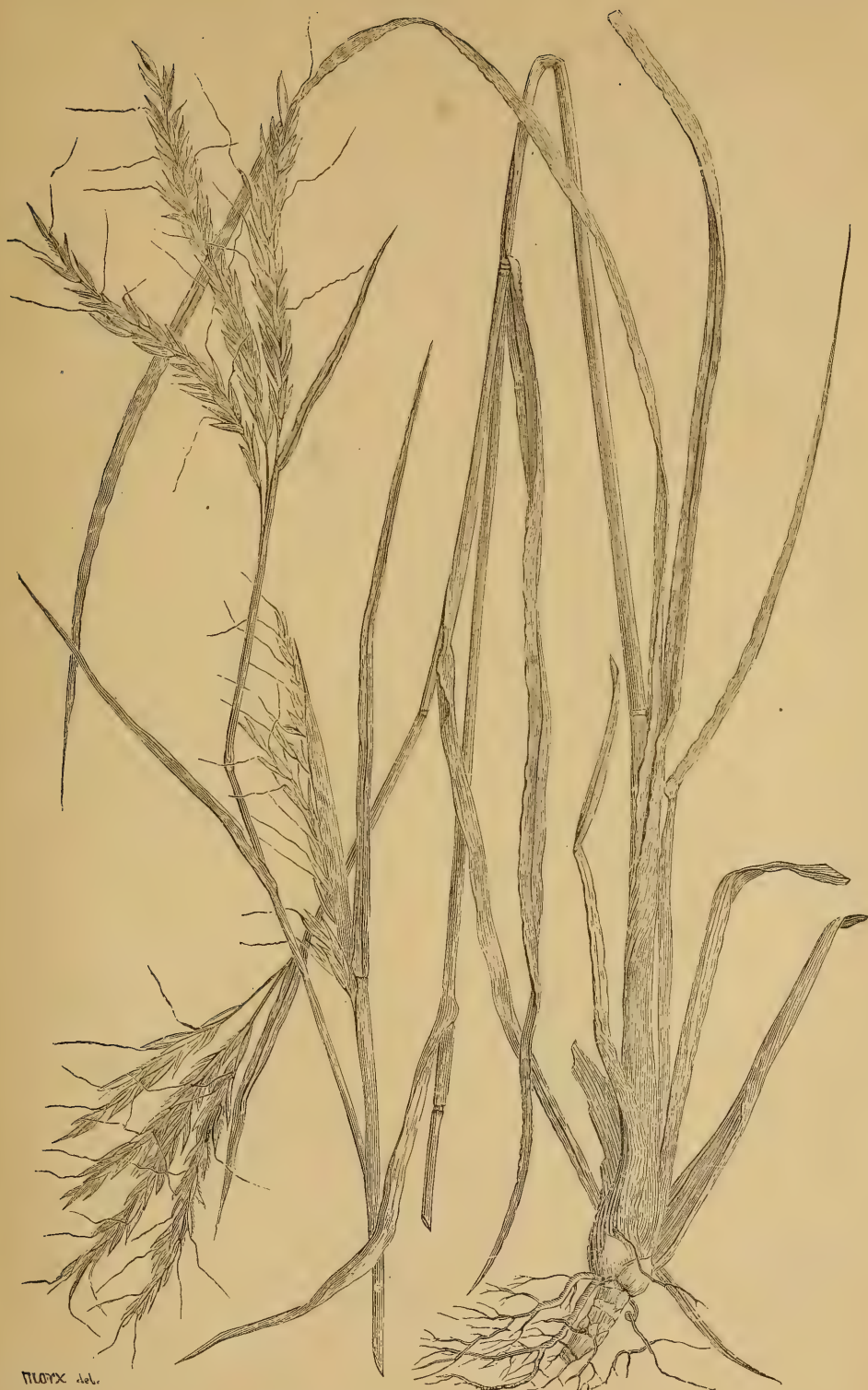
BOUTELOUA OLIGOSTACHYA. GRAMMA-GRASS.



NICHOLS

MARX-DEL.

BUCHLOE DACTYLOIDES BUFFALO-GRASS.



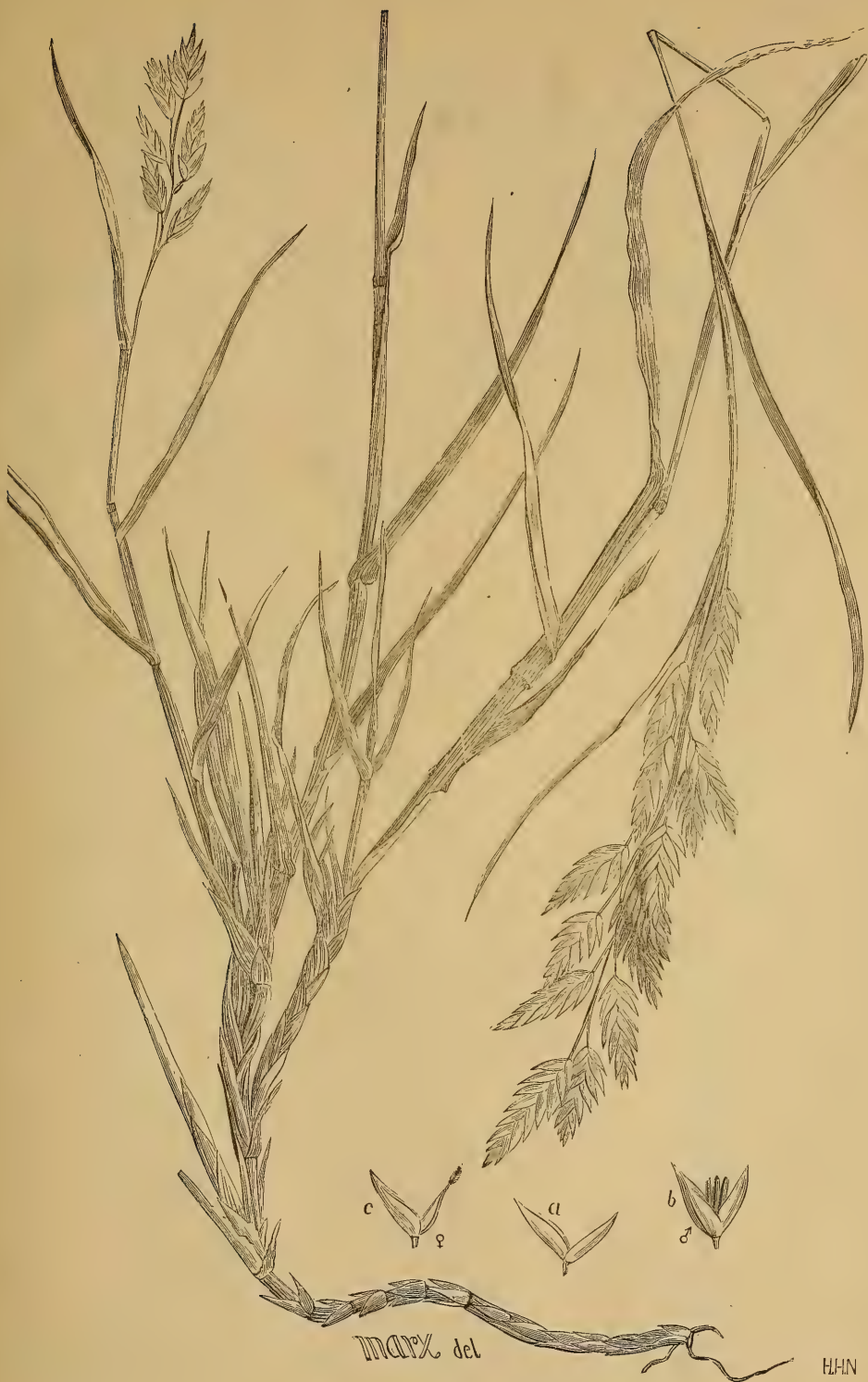
ANDROPOGON PROVINCIALIS. BLUE-JOINT.



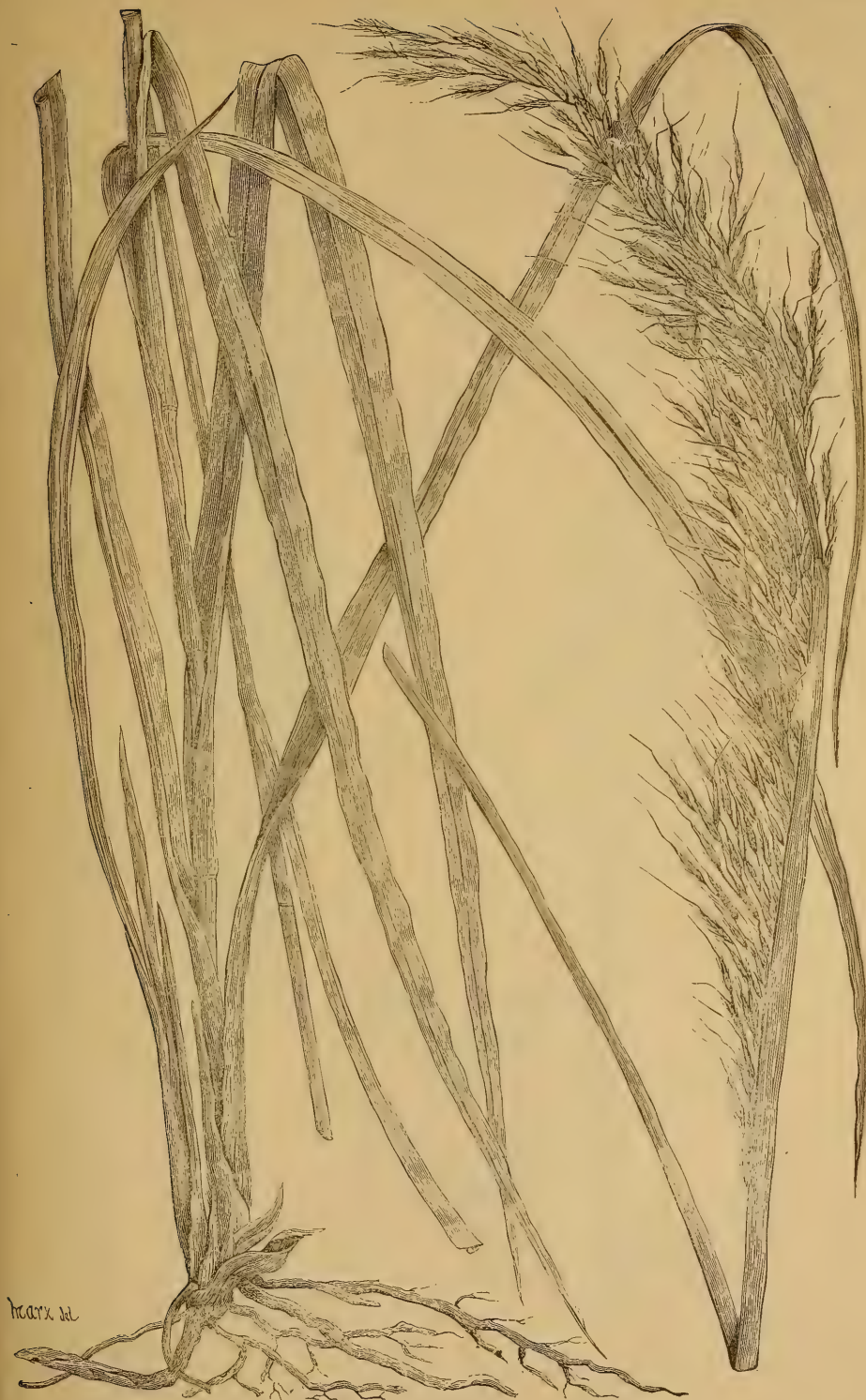
ANDROPOGON SCOPARIUS. WIRE-GRASS. SEDGE-GRASS.



PANICUM VIRGATUM. SWITCH-GRASS.



DISTICHLIS MARITIMA. ALKALI-GRASS. SALT-GRASS.



Marx del

CHRYSOPOGON NUTANS. REED-GRASS. SORGHUM-GRASS.



T. TAYLOR DEL.

H. H. NICHOLS.

KOELERIA CRISTATA. WILD JUNE-GRASS.



MARX.DEL

H.H.NICHOLS.EJ

MUHLENBERGIA GLOMERATA.



HILARIA JAMESII.



SPOROBOLUS CRYPTANDRUS.



SPOROBOLUS AIROIDES. BUNCH-GRASS.



ELYMUS CANADENSIS. RYE-GRASS.



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